What is claimed is:

1. A communication system employing orthogonal block encoding, comprising:

a transmitter for repetitively transmitting encoded signals including mutually orthogonally encoded repeated blocks of symbols, the symbols in the repeated blocks representing successive samples of an informational source signal; and

a receiver for decoding the orthogonally encoded repeated blocks of symbols of the encoded signals.

2. The communication system as recited in claim 1 wherein the receiver employs different orthogonal codes to separate the encoded signals into corresponding separate channels.

3. The communication system as recited in claim 1 comprising:

a memory for storing an orthogonal code; and

a phase shifter for responding to the stored orthogonal code for imposing a corresponding sequence of phase changes onto at least one of the mutually repeated block.

4. The communication system as recited in claim 1 wherein the receiver comprises:

an orthogonal block code remover for removing the orthogonal encoding from the encoded transmitted signals; and

an adder for adding corresponding ones of the symbols in successively received repeated blocks from the transmitter after the orthogonal encoding is removed by the orthogonal code remover to form a summed signal for each symbol within the repeated blocks.

5. The communication system as recited in claim 4 comprising a transmitter for transmitting the repeated blocks at a preselected rate and for adding symbols in successive ones of the repeated blocks.

6. The communication system as recited in claim 4 wherein the receiver comprises an equalizer for processing the summed signal from the adder to compensate for multipath propagation.

7. The communication system as recited in claim 1 comprising a digital source encoder for producing the symbols as digital bits of information.

8. The communication system as recited in claim 7 comprising:

bit repeater for repeating each bit of information produced by the digital source encoder a preselected number of times to successively produce groups of repeated bits;

sign imposer for selectively imposing a sign change on the repeated bits of each of a number of successive groups of repeated bits equal to the preselected number of bits in each group in accordance with an orthogonal code;

interleaver for interleaving the sign changed bits from the preselected number of groups to successively generate a number of blocks each composed of the different sign changed bits of the preselected numbers of repeated groups and having a collective sign change corresponding to a common sign change shared by all signed changed bits of the block; and

a signal modulator for transmitting a signal modulated in accordance with the generated blocks with sign changes corresponding to the orthogonal code.

9. A communication system employing orthogonal block encoding, comprising:

a plurality of transmitters for repetitively transmitting encoded signals comprised of mutually orthogonally encoded repeated blocks of symbols respectively representing samples of an informational source signal produced at each transmitter; and

a receiver for receiving the encoded transmitted signals, and for decoding the orthogonally encoded repeated blocks of symbols of the transmitted encoded signals received from the plurality of transmitters, by employing different ones of a plurality of orthogonal codes respectively associated with different ones of the plurality of transmitters to separate the received encoded signals into corresponding separate channels.

10. The communication system as recited in claim 9 wherein each of the transmitters comprises:

a memory for storing an orthogonal code; and

a responder responsive to the stored orthogonal code for imposing a corresponding sequence of phase changes onto each repeated block.

11. The communication system as recited in claim 10 wherein the responder selectively imposes a 180° phase shift onto the repeated blocks in accordance with the stored orthogonal code.

12. The communication system as recited in claim 11 wherein the memory comprises a memory for storing a Walsh-Hadamard code having a number of bits equal to the number of times the transmitters repeatedly transmit the repeated blocks.

13. The communication system as recited in claim 9 wherein the receiver comprises:

an orthogonal code remover for removing the orthogonal encoding from the encoded transmitted signals; and

an adder for adding corresponding ones of the symbols in successively received repeated blocks from one of the plurality of transmitters after the orthogonal encoding is removed by the orthogonal code remover to form a summed signal for each symbol within the repeated blocks.

14. The communication system as recited in claim 13 wherein

the blocks are transmitted at a preselected block repetition rate which results in a preselected repetition period; and

the adder comprises another adder for adding the corresponding symbols in successive repeated blocks which are separated from each other by an amount equal to the repetition period.

15. The communication system as recited in claim 14 wherein each of the transmitters comprises:

an orthogonal encoder for selectively imposing phase shifts to the repeated blocks while being transmitted in accordance with an associated one of a plurality of the different orthogonal codes; and

the receiver comprises a block remover for removing each of the repeated blocks received from each of the plurality of transmitters in accordance with the orthogonal code respectively associated with the transmitters being decoded before being applied to the adder.

16. The communication system as recited in claim 13 wherein each of the transmitters comprises:

an orthogonal encoder for selectively imposing phase shifts to the repeated blocks while being transmitted in accordance with an associated one of a plurality of the different orthogonal codes; and

the receiver comprises a block remover for removing each of the repeated blocks received from each of the plurality of transmitters in accordance with the associated one of the plurality of different orthogonal codes being decoded before being applied to the adder.

17. The communication system as recited claim 13 wherein the receiver comprises an equalizer for processing the summed signal from the adder to compensate for multipath propagation effects.

18. The communication system as recited in claim 9 wherein each of the plurality of transmitters comprises a digital source encoder for producing the symbols as digital bits of information.

19. The communication system as recited in claim 18 wherein each of the plurality of transmitters comprises:

a repeater for repeating each bit of information produced by the digital source encoder a preselected number of times to successively produce groups of repeated bits;

a sign changer for selectively imposing a sign change on the repeated bits of each of a number of successive groups of repeated bits equal to the preselected number of bits in each group in accordance with an orthogonal code associated with the transmitter;

an interleaver for interleaving the sign changed bits from the preselected number of groups to successively generate a number of blocks each composed of the different sign changed bits of the preselected number of repeated groups and having a collective sign change corresponding to a common sign change shared by all signed changed bits of the block; and

a sign modulator for transmitting a signal modulated in accordance with the generated blocks with sign changes corresponding to the orthogonal code.

20. The communication system as recited in claim 19 wherein each of the transmitters comprises an error correction encoder for imposing error correction encoding upon each of the digital bits of information from the digital source encoder.

21. The communication system as recited in claim 19 wherein each of the transmitters comprises:

an access code generator for generating access code sequences at the rate at which digital bits of information are produced by the digital source encoder; and

an access code imposer for imposing the access code onto the individual digital bits of each of the orthogonally encoded blocks.

22. The communication system as recited in claim 21 wherein the receiver comprises an access code decoder for decoding the individual digital bits of information received at the receiver.

23. The communication system as recited in claim 19 wherein the decoder comprises a deinterleaver for separating the blocks into individual digital bits.

24. The communication system as recited in claim 23 comprising a maximum likelihood equalizer for equalizing the individual digital bits from the deinterleaver.

25. The communication system as recited in claim 23 wherein the receiver comprises an error correction decoder.

26. A method for orthogonal block encoding, comprising the steps of:

transmitting repetitively encoded signals comprised of mutually orthogonally encoded repeated blocks of symbols, the symbols in the repeated blocks representing successive samples; and

decoding the orthogonally encoded repeated blocks of symbols of the transmitted encoded signal.

27. The method as recited in claim 26 wherein the step of decoding comprises the step of employing different orthogonal codes respectively for separating the received encoded signals into corresponding separate channels.

28. The method as recited in claim 26 comprising the steps of:

storing an orthogonal code; and

imposing a corresponding sequence of phase changes onto a repeated block in response to the stored orthogonal code.

29. The method as recited in claim 26 comprising the steps of:

removing the encoded signals from the encoded transmitted signals; and

adding corresponding ones of the symbols in repeated blocks after the orthogonal encoding is removed.

30. The method as recited in claim 29 comprising the step of transmitting the blocks at a preselected rate and adding symbols in successive repeated blocks.

31. The method as recited in claim 29 wherein the steps of removing the orthogonal coding comprising the steps of:

forming a summed signal for each symbol within the repeated blocks; and

processing the summed signal with an equalizer.

32. The method system as recited in claim 26 comprising the step of encoding the symbols as digital bits of information.

33. The method as recited in claim 32 comprising the steps of:

repeating each bit of information produced by the digital source encoder a preselected number of times to successively produce groups of repeated bits;

imposing a sign change on the repeated bits of each of a number of successive groups of repeated bits equal to the preselected number of bits in each group in accordance with an orthogonal code;

interleaving the sign changed bits from the preselected number of groups to successively generate a number of repeated groups and having a collective sign change corresponding to a common sign change shared by all signed changed bits of the block; and

transmitting a signal modulated in accordance with the generated blocks with sign changes corresponding to the orthogonal code.

34. In a communication system having a plurality of transmitters and a receiver for communicating with the transmitters, a method for orthogonal block encoding, comprising the steps of:

repetitively transmitting from each of the plurality of transmitters encoded signals with mutually orthogonal encoded repeated blocks of symbols respectively representing successive samples of an informational source signal produced at the transmitter; and

decoding the orthogonally encoded repeated blocks of the transmitted encoded signals received from all the plurality of transmitters at the receiver by employing different ones of a plurality of orthogonal codes respectively associated with different ones of the plurality of transmitters for separating the received encoded signals into corresponding channels.

35. The method as recited in claim 34 in which the step of transmitting includes the steps of:

storing at each transmitter a different one of a plurality of orthogonal codes at each of the plurality of transmitters; and

imposing a sequence of phase changes onto each repeated block in accordance with the stored orthogonal code.

36. The method as recited in claim 35 wherein the step of imposing a sequence comprises the step of selecting a 180 degree phase shift for imposing onto the repeated blocks in accordance with the stored orthogonal code.

37. The method as recited in claim 36 wherein the step of storing comprises the step of:

selecting a Walsh-Hadamard code having a number of bits equal to the number of times the transmitters repeatedly transmit the repeated blocks.

38. The method as recited in claim 34 wherein the step of decoding comprises the steps of:

removing the orthogonal encoding from the encoded transmitted signals; and

adding corresponding ones of the symbols in successively received repeated blocks from one of the plurality of transmitters after the orthogonal encoding is removed by the encoder to form a summed signal for each symbol within the repeated blocks.

39. The method as recited in claim 38 comprising the steps of:

transmitting the blocks by a preselected block repetition rate which results in a preselected repetition period ; and

adding the corresponding symbols in successive repeated blocks which are separated from each other by an amount equal to the repetition period.

40. The method as recited in claim 39 comprising the steps of:

selectively imposing phase shifts to the repeated block with an orthogonal encoder while being transmitted in accordance with an associated one of a plurality of the different orthogonal codes; and

removing each of the repeated blocks received from each of the plurality of transmitters in accordance with the orthogonal code respectively associated with the transmitters being decoded before adding the corresponding one of the symbols.

41. The method as recited in claim 38 comprising the steps of:

selectively imposing phase shifts to the repeated blocks while being transmitted in accordance with an associated one of a plurality of the different orthogonal codes; and

removing each of the repeated blocks received from each of the plurality of transmitters in accordance with the orthogonal code respectively associated with the transmitters being decoded before adding the corresponding one of the symbols.

42. The method as recited in claim 38 comprising the step of processing the summed signal to compensate for multipath propagation effects.

43. The method as recited in claim 34 comprising the step of producing the symbols as digital bits of information.

44. The method as recited in claim 43 comprising the steps of:

repeating each bit of information produced a preselected number of times to successively produce groups of repeated bits; and

selectively imposing a sign change on the repeated bits of each of a number of successive groups of repeated bits equal to the preselected number of bits in each group in accordance with an orthogonal code associated with the transmitter;

interleaving the signed changed bits from the preselected number of groups to successively generate a number of blocks each composed of the different sign changed bits of the selected number of repeated groups and having a collective sign change corresponding to a common sign change shared by all signed changed bits of the block; and

transmitting a signal modulated in accordance with the generated blocks with sign changes corresponding to the orthogonal code.

45. The method as recited in claim 44 comprising the step of imposing error correction encoding upon each of the digital bits of information.

46. The method as recited in claim 44 comprising the steps of:

generating access code sequences at the rate at which digital bits of information are produced by the digital source encoder; and

imposing the access code onto the individual digital bits of each of the orthogonally encoded blocks.

47. The method as recited in claim 46 comprising the step of decoding the individual digital bits of information received at the receiver.

48. The method as recited in claim 44 comprising the step of separating the blocks into individual digital bits.

49. The method as recited in claim 48 comprising the step of equalizing the individual digital bits with a maximum likelihood equalizer.

50. The method as recited in claim 49 comprising the step of including an error correction decoding for the receiver.

51. A method of transmitting a spread-spectrum encoded signal with improved tolerance of multipath propagation, comprising the steps of:

encoding information to produce symbol blocks containing a predetermined first number of symbols;

repeating transmission of each symbol block a selected number of times; and

changing a sign of each successively repeated block according to a preselected sequence of sign changes.

52. The method as recited in claim 51 in which the spread-spectrum coded signal is further conditioned prior to transmission by combining with a spread-spectrum access code.

53. The method as recited in claim 52 in which the spread-spectrum access code is used in common by different transmitters.

54. The method as recited in claim 51 in which the selected sequence of sign or phase changes is different for a different transmitter.

55. The method as recited in claim 54 in which the different sequences are orthogonal to one another.

56. A method for decoding a spread-spectrum coded signal, comprising the steps of:

receiving a composite signal, the composite signal being a sum of a number of overlapping spread-spectrum signals including said coded signal and sampling the composite signal to produce signal samples;

combining selected ones of the signal samples separated by a predetermined number of samples using a phase change selected from a preassigned pattern of phase changes associated with a particular one of the overlapping spread-spectrum signals to produce despread samples; and

processing the despread samples using an equalizer to compensate for multipath propagation.

57. A transmitter for use in a communication system employing orthogonal block encoding, the transmitter comprising:

a producer of an information source signal;

a transmitter circuit for repetitively transmitting encoded signals comprised of mutually orthogonally encoded repeated blocks of symbols respectively representing samples of the informational source signal;

a memory for storing an orthogonal code; and

a phase shifter responsive to the stored orthogonal code for imposing a corresponding sequence of phase changes into each repeated block.

58. The transmitter as recited in claim 57 comprising a digital source encoder for producing the symbols as digital bits of information.

59. The transmitter as recited in claim 58 comprising:

a repeater for repeating each bit of information produced by the digital source encoder a preselected number of times to successively produce groups of repeated bits;

a sign changer for selectively imposing a sign change on the repeated bits of each of a number of successive groups of repeated bits equal to the preselected number of bits in each group in accordance with an orthogonal code associated with the transmitter;

an interleaver for interleaving the sign changed bits from the preselected number of groups to successively generate a number of blocks each composed of the different sign changed bits of the preselected number of repeated groups and having a collective sign change corresponding to a common sign change shared by all signed changed bits of the block; and

a sign modulator for transmitting a signal modulated in accordance with the generated blocks with sign changes corresponding to the orthogonal code.

60. The transmitter as recited in claim 59 comprising an error correction encoder for imposing error correction encoding upon each of the digital bits of information from the digital source encoder.

61. A receiver for use in processing encoded transmitted signals having mutually orthogonally encoded repeated blocks of symbols the receiver comprising a receiver circuit for receiving the encoded transmitted signals, and for decoding the orthogonally encoded repeated blocks of symbols of the transmitted encoded signals received from the transmitters, by employing different ones of a plurality of orthogonal codes respectively associated with different ones of a plurality of orthogonal codes associated with different ones of the transmitters to separate the received encoded signals into corresponding separate channels.

62. The receiver as recited in claim 61 comprising:

an orthogonal code remover for removing the orthogonal encoding from the encoded transmitted signals; and

an adder for adding corresponding ones of the symbols in successively received repeated blocks after the orthogonal encoding is removed by the orthogonal code remover to form a summed signal for each symbol within the repeated blocks.

63. The receiver as recited in claim 62 wherein the blocks are transmitted at a preselected block repetition rate which results in a preselected repetition period; and

the adder comprises another adder for adding the corresponding symbols in successive repeated blocks which are separated from each other by an amount equal to the repetition period.

64. The receiver as recited in claim 63 wherein the receiver comprises a block remover for removing each of the repeated blocks received from the transmitter in accordance with the orthogonal code associated with the transmitter before being applied to the adder.

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